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RELATIONSHIP OF GRADE TO THE PROCESSING QUALITY OF COTTON

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Relationship of Grade to the Processing Quality of Cotton

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ABSTRACT

Eleven grades of cotton were processed in three replications from picking through drawing. Six replications were spun from each grade at ring spinning, and three replications were spun from each grade at open-end spinning. Results of fiber tests show a considerable range in properties among the grades, and the grades with the better fiber properties produced the higher quality yarns. Multiple regression was used to determine the effects of grade on yarn quality. Approximately 50 to 70 percent of the variation in yarn quality is attributable to grade. In order to negate the effects of differences in fiber properties among grades, the yarn quality factors were normalized. After the effects of variations in fiber properties were removed, there appeared to be little relationship between grade and spinning performance or yarn quality. KEYWORDS: cotton, cotton fiber properties (among grades), cotton grades, cotton processing, yarn quality variation (among cotton grades).

INTRODUCTION

Cotton is bought and sold on the basis of grade, staple, and micronaire reading. According to U.S. Department of Agriculture Miscellaneous Publication No. 310, "Cotton is classed to determine the grade and staple length, which indicate to a large extent the spinning utility and hence the market value of each bale."[4] The farmer uses grade and staple to appraise his production practices and market his cotton. The grade should only reflect degree of color, trash, and preparation. However, the classer's assessment of the grade of a cotton sample appears to be influenced by length, length uniformity, fineness, and strength of the cotton fibers (see footnote 4). Recent trends during ginning have been toward more rigorous cleaning treatments. This has resulted in less trash for the same cotton grade than in the past.[5] Because of the many technological changes and variations in production, harvesting, and ginning practices, a need for more precise segregation of the individual bales of cotton during the yarn manufacturing process exists.

The objective of this study was to determine the extent to which grade is related to both spinning performance and yarn quality, using cotton from the 1974–75 crop. In this publication grade designation is expressed as a two-digit code number in which the first digit indicates the amount of trash in the cotton, and the second digit indicates the color of the cotton.

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[4]The classification of cotton, 53 pp. 1965.

[5]Newton, F. E. A new look at cotton quality relationships. Text. Ind. (Atlanta), pp. 132–138. September 1960.

EXPERIMENTAL PROCEDURE

SAMPLE SELECTION

Three bales from each of 11 grades of cotton (table 1) were chosen for processing from the 1974–75 crop, which was classed by USDA's Agricultural Marketing Service Office in Little Rock, Ark. Each bale was selected when a particular grade was most prevalent in the stock being classed. There were significant differences in fiber properties among the individual bales within most of the grades. Efforts were made to select bales with staple lengths of either 34 or 35 thirty-seconds of an inch. The minimum micronaire reading was 3.5 for bales classed as white or light spotted and 3.2 for bales classed as spotted. Three replications were run from picking through drawing. At ring spinning, six replications were spun from each grade for a total of 66 spinning lots. Three replications were spun from each grade at open-end spinning for a total of 33 spinning lots.

PROCESSING

Fourteen-ounce-per-yard laps were carded into 50-grain-per-yard sliver at 20 pounds per hour. Eight ends were fed to both breaker and finisher drawings. A 53-grain sliver was formed at breaker drawing and a 55-grain sliver at finisher drawing; both were processed at a front-roll speed of 265 feet per minute. A 1.00-hank, 1.30-twist-multiplier roving was formed at a spindle speed of 900 revolutions per minute. Yarn was spun on four Saco-Lowell ring spinning frames equipped with Duo-Roth drafting systems and also on a Platt Saco-Lowell type 883 open-end spinning frame. The ring yarns were spun at a spindle speed of 11,000 revolutions per minute into a 40s (15-tex) yarn with a 3.89 twist multiplier. The open-end yarn was spun at a rotor speed of 46,000 revolutions per minute into an 18s (33-tex) yarn with a 5.00-twist multiplier.

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one sample of finisher-drawing sliver from each creeling, of which there were three per grade. Shirley analyzer tests were made to determine nonlint content, using two 100-grain samples of ginned lint per bale. Color measurements were made on ginned-lint samples before and after Shirley analyzer tests. Official classification data were determined by USDA's Board of Supervisory Cotton Examiners, Memphis, Tenn.

Table 1.—Grade designations and code numbers for test cottons

Classer's grade	Abbreviation	Code No.[1]
Strict Middling (white)	SM	21
Middling (white)	M	31
Middling Light Spotted	MLtSp	32
Middling Spotted	MSp	33
Strict Low Middling (white)	SLM	41
Strict Low Middling Light Spotted	SLMLtSp	42
Strict Low Middling Spotted	SLMSp	43
Low Middling (white)	LM	51
Low Middling Light Spotted	LMLtSp	52
Low Middling Spotted	LMSp	53
Strict Good Ordinary (white)	SGO	61

[1]1st digit of code number indicates percentage of trash content in the cotton: 2=1.8 pct trash, 3=2.2 pct trash, 4=3.0 pct trash, 5=4.2 pct trash, 6=5.4 pct trash. 2d digit indicates color of the cotton: 1=white, 2=light spotted, 3=spotted.

For each spinning lot, one measurement of skein strength and one of yarn size were made on each of 40 bobbins from the ring spinning frames, and one of each of these measurements was made on each of 20 tubes from the open-end spinning frame. Sixteen bobbins of ring yarn and eight tubes of open-end yarn per replication were tested for yarn evenness and imperfections. The sensitivity of the imperfection indicator was set at 30 percent for thin places and at setting number 4 for thick places and neps. Yarn from each bobbin or tube was tested at 25 yards per minute for 5 minutes. Ten single-strand strength measurements were made on each of the 40 bobbins of ring-spun yarn and on each of the 20 tubes of open-end yarn. Yarn grade was determined from three yarn boards per spinning lot by three technicians for each yarn replication.

STATISTICAL ANALYSIS

The data from this study were analyzed by multiple regression and by comparison of means, using Duncan's multiple-range test at the 95-percent level of significance. Because of the significant differences in mean fiber properties between grades, it was considered desirable to remove the influence of these differences on spinning performance and yarn properties. Multiple regression analysis was performed with the individual spinning-performance and yarn-property values as dependent variables and the values for 2.5-percent span length, length uniformity, Pressley strength, and micronaire as

the independent variables. The yarn properties were then adjusted or normalized by using the partial regression coefficients of each independent variable and adjusting the individual fiber-property values to their mean values. Therefore, each resulting normalized spinning-performance and yarn-property value represents the composite adjustment of the four fiber properties to their mean values.

RESULTS AND DISCUSSION

MANUFACTURING WASTE

The amount of processing waste through carding increased approximately linearly with grade designation. This trend agreed well with the nonlint content as measured by the Shirley analyzer; figure 1 shows this relationship. The percentage of nonlint content ranged from 1.2 for SM (21) to 5.6 for SGO (61). Results of the annual cotton quality survey[6] show that the percentage of nonlint contents ranged from 1.7 for SM to 6.9 for SGO, based on all samples tested between 1968 and 1972. These results indicate a continuing trend of smaller average percentages of nonlint content in cotton classed into the various grades.[7]

FIBER PROPERTIES

Ginned lint

The results of fiber-property tests on the ginned lint samples are shown in table 2. The mean 2.5-percent span lengths and length uniformities were significantly different among several of the grades. Measurements of 2.5-percent span length ranged from 1.087 inches for SGO (61) to 1.153 inches for MLtSp (32). Length uniformity ranged from 41.0 percent for SGO to 43.7 percent for SM (21), SLMLtSp (42), and SLMSp (43). There were also significant differences among grades for Pressley-strength and micronaire readings. The highest Pressley strength was 23.7 grams per tex for SM, and the lowest was 21.8 grams per tex for M (31).

[6]Summary of cotton fiber and processing test results, crop of 1974, 120 p. U.S. Agricultural Marketing Service, Cotton Division. May 1975.

[7]Cotton fiber and processing properties as related to grades. U.S. Agric. Mark. Serv. [Rep.] AMS–278, 73 pp. 1958.

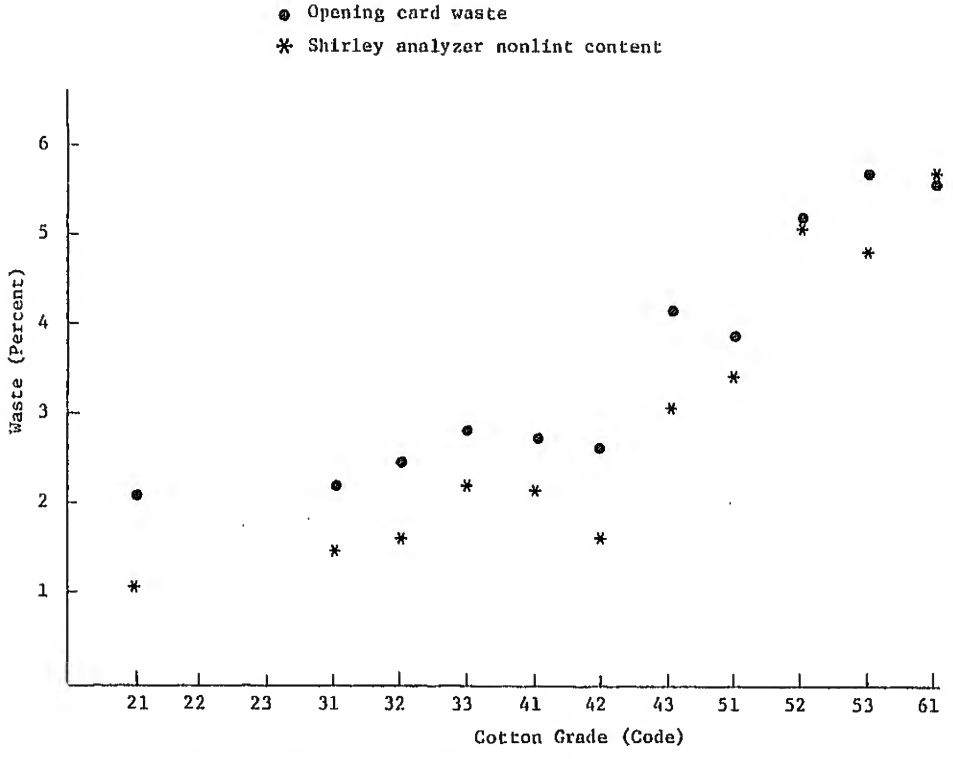

FIGURE 1.—Opening-through-carding processing waste and Shirley-analyzer nonlint content versus cotton grade.

Table 2.—Results of fiber-property tests on ginned lint[1]

Code No.[2]	2.5-pct span length (inches)	Length uniformity (pct)	Pressley strength, ⅛-inch gage (g/tex)	Micronaire reading	Nonlint content (pct)	Colorimeter: Ginned lint R_d	Colorimeter: Ginned lint $+b$	Colorimeter: Cleaned lint R_d	Colorimeter: Cleaned lint $+b$
21	1.120abc	43.7a	23.7a	4.4abc	1.13i	76.2a	9.8g	78.8a	9.4e
31	1.130abc	43.0ab	21.8b	4.8a	1.54h	70.3c	9.9f	77.0b	9.1g
32	1.153a	42.0abc	22.1b	4.2bcd	1.72g	66.0f	10.0e	74.2d	9.4f
33	1.100abc	42.7abc	23.0ab	4.0cd	2.24f	65.0h	11.2b	73.4e	10.6c
41	1.093bc	42.7abc	22.7ab	4.1bcd	2.20f	73.5b	9.7i	75.5c	9.1g
42	1.113abc	43.7a	23.1ab	4.6ab	1.68g	67.2e	10.1d	72.8f	9.8d
43	1.140ab	43.7a	23.2ab	3.4e	3.15e	67.6d	11.6a	69.2i	11.8a
51	1.107abc	41.7bc	22.3ab	3.9cde	3.50d	65.4g	8.2j	72.6g	8.4h
52	1.120abc	42.7abc	23.1ab	4.0cd	5.22b	64.1i	9.4h	68.5j	9.8d
53	1.133abc	43.3ab	23.0ab	3.7de	4.88c	62.1j	10.7c	68.5j	10.8b
61	1.087c	41.0c	22.1b	3.7de	5.70a	65.3g	7.5k	70.1h	7.9i

[1]Means in a column not having a suffix letter in common are different at the 95-pct level of significance.
[2]See table 1.

Micronaire reading ranged from a low of 3.4 for SLMSp to a high of 4.8 for M. Because of significant variations in these four important fiber parameters, their effects were removed from the spinning-performance and yarn-quality data by a normalizing process, as explained in "Normalized Yarn-Quality Data."

These relationships between grade and span length, length uniformity, Pressley strength, and micronaire become clearer when a larger number of bales per grade are sampled.[8] Cottons classed into higher grades tend to be longer, more uniform in length, higher in micronaire, and stronger than those classed into lower grades.

Multiple regression r^2 values for the trash and color components of grade designation and the individual fiber properties are given in table 3 along with their associated probabilities. The fiber properties with an r^2 significant to at least the 95-percent level (0.05 probability) were micronaire, nonlint content, reflectance (R_d), and degree of yellowness ($+b$) for both ginned lint and cleaned lint.

Finisher-drawing sliver

The range of values for each of the finisher-drawing fiber properties shown in table 4 was greater than those for the ginned lint except for micronaire, which was unchanged. The ranges were 2.5-percent span length, 1.13 to 1.21 inches; length uniformity, 48.3 to 52.3 percent; Pressley ⅛-inch gage, 18.7 to 22.3 grams per tex; and micronaire reading, 3.4 to 4.8.

Spinning Performance

Ends-down data were recorded for ring-spun yarn only. These are shown, along with yarn-property results, in table 5. For the white grades, the ends-down level increased exponentially with trash designation. Within a trash designation, however, there was a trend for the ends-down level to decrease as the color-designation number increased from 1 to 3 (white through spotted).

Yarn Properties

Ring-spun yarns

Break factor and single-strand strength (table 5) were highest for SM (21) and SLMSp (43) and lowest for LM (51) and SGO (61). The range in strength

[8]See footnote 7 on p. 3.

Table 3.—Multiple regression r^2 values and probability levels of fiber properties and the trash and color components of grade designation

Fiber property	r^2	Probability
2.5-pct span length .....inch...	0.299	0.242
Length uniformity .....pct...	.427	.108
Pressley strength,		
⅛-inch gage .....g/tex...	.225	.362
Micronaire reading	.540	.045
Shirley analyzer nonlint .....pct...	.833	.001
Reflectance, ginned lint .....R_d...	.721	.006
Yellowness, ginned lint .....$+b$...	.929	.001
Reflectance, cleaned lint .....R_d...	.947	.001
Yellowness, cleaned lint .....$+b$...	.783	.002

among the grades tested is approximately the same as that reported by Newton.[9] There was a decrease in break factor and single-strand strength for the white grades as trash designation increased numerically. For the white grades, increasing trash designations resulted in lower single-strand elongations and higher strength coefficients of variability (CV). The SLMSp cotton produced the highest percentage of elongation, and M (31) produced the lowest. The lowest strength CV was recorded for the SLMSp and the highest for LM. Appearance index was the best for MSp (33) and the worst for SGO. The relationship between grade and yarn appearance was not as weak as was previously suggested (see footnote 5). The lowest evenness CV and lowest number of neps were those for SLMSp, while the highest values for these two properties were those for SGO. For the white grades, the appearance index decreased and the number of neps and evenness CV increased as trash designation increased numerically.

In most cases, the light-spotted and spotted cottons produced yarns with properties superior to those of the white cottons. The best results were usually obtained with the spotted cottons. Within each trash designation, the light-spotted and spotted cottons also possessed better ginned-lint fiber properties than did the white cottons. For the white cottons, the yarn properties deteriorated, as might be expected, with increasing numerical values of grade designation. The SLMSp cotton generally outperformed the cottons in the other grades. Overall, SGO produced the poorest results.

Open-end yarns

Yarn-quality data for open-end yarns are shown in table 6. The SLMSp cotton (43) produced yarn with the highest single-strand strength, the highest elongation, the least number of neps, and the lowest evenness CV. However, the appearance index of this cotton was extremely low. In contrast, M (31) yielded a low single-strand strength, a high strength CV, the greatest number of yarn neps, and the highest evenness CV. However, the yarn from this cotton had the highest yarn appearance index. For the ring-spun yarns (table 5), a high appearance index was usually associated with a low number of neps and a low value of evenness CV; but

(*Continued on page 8.*)

[9]See footnote 5 on p. 1.

Table 4.—Results of fiber-quality tests on finisher-drawing sliver[1]

Code No.[2]	2.5-pct span length (inches)	Length uniformity (pct)	Pressley strength, ⅛-inch gage (g/tex)	Micronaire reading
21	1.187de	51.3ab	22.3a	4.40b
31	1.203abc	49.7abc	21.8ab	4.80a
32	1.207ab	49.3bc	21.3bc	4.07cd
33	1.170fg	51.0abc	21.6abc	3.97de
41	1.157g	49.0bc	20.1d	4.13c
42	1.190cde	52.3a	21.3bc	4.50b
43	1.210a	51.3ab	20.7cd	3.37g
51	1.180ef	48.3c	20.3d	3.90e
52	1.193bcde	50.3abc	20.7cd	3.97de
53	1.200abcd	51.0abc	21.6abc	3.67f
61	1.130h	49.0bc	18.7e	3.53f

[1]Means in a column not having a suffix letter in common are different at the 95-pct level of significance.

[2]See table 1.

Table 5.—Results of spinning performance and quality tests on ring-spun yarns[1]

Code No.[2]	Ends down (No./1,000 spindle-hours)	Break factor	Yarn appearance index	Single-strand strength (g/tex)	Single-strand elongation (pct)	Single-strand strength CV (pct)	Neps (No./1,000 yd)	Evenness CV (pct)
21	8f	1,952a	88bc	13.4a	6.9b	11.3de	734ef	22.8e
31	12de	1,818d	88bc	12.3de	5.5g	11.8bcd	1,104c	24.4b
32	8f	1,786e	88bc	12.2de	6.7c	11.0de	1,086c	24.0bc
33	8f	1,856c	92a	12.4cd	6.3de	10.8e	811e	23.1e
41	18c	1,705f	85c	11.9f	6.1f	12.2abc	1,072c	23.7c
42	9ef	1,827d	89ab	12.6bc	6.2ef	11.2de	933d	23.1e
43	8f	1,968a	85c	13.3a	7.2a	9.8f	686f	21.9f
51	32b	1,644g	80d	11.3g	5.6g	12.7a	1,094c	23.8c
52	14d	1,770e	84c	12.1ef	5.6g	11.4cde	1,127c	23.3de
53	9ef	1,894b	80d	12.8b	6.4d	10.8e	1,223b	23.7cd
61	51a	1,541h	75e	11.2g	5.6g	12.6ab	1,394a	24.8a

[1]Means in a column not having a suffix letter in common are different at the 95-pct level of significance.
[2]See table 1.

Table 6.—Results of quality tests on open-end yarns[1]

Code No.[2]	Break factor	Yarn appearance index	Single-strand strength (g/tex)	Single-strand elongation (pct)	Single-strand strength CV (pct)	Neps (No./1,000 yd)	Evenness CV (pct)
21	1,676a	80ab	9.9c	6.1b	8.1ab	660bc	15.8b
31	1,543cd	85a	9.5d	4.8d	9.0a	991a	16.8a
32	1,624abc	75bcd	10.0bc	6.4b	7.7ab	707b	15.7b
33	1,614abc	70d	9.7cd	6.1b	7.8ab	588bc	15.4bc
41	1,597abc	73cd	9.0e	5.3c	8.7a	592bc	15.3bcd
42	1,569bcd	73cd	9.5d	5.6c	9.0a	708b	15.8b
43	1,668ab	71d	10.29a	6.9a	7.5ab	478c	14.8d
51	1,483d	77bc	8.9e	5.4c	8.2ab	593bc	15.0cd
52	1,552cd	79b	9.3d	5.5c	8.4a	593bc	15.2bcd
53	1,673a	73cd	10.26ab	6.2b	7.9ab	754b	15.7b
61	1,488d	72cd	8.9e	5.6c	5.4b	565bc	14.9d

[1]Means in a column not having a suffix letter in common are different at the 95-pct level of significance.
[2]See table 1.

Table 7.—Results of normalizing the spinning-performance and yarn-property values of ring-spun yarns[1]

Code No.[2]	Ends down (No./1,000 spindle-hours)	Break factor	Yarn appearance index	Single-strand strength (g/tex)	Single-strand elongation (pct)	Single-strand strength CV (pct)	Neps (No./1,000 yd)	Evenness CV (pct)
21	23a	1,790a	82b	12.3a	6.2Sab	12.2a	1,020bc	23.9ab
31	13ab	1,873a	85b	12.7a	6.0ab	11.2a	974bc	23.3ab
32	14ab	1,740a	86b	12.0a	6.35a	11.8a	1,056abc	23.8ab
33	4b	1,871a	92a	12.3a	6.2ab	10.9a	837c	23.3ab
41	5b	1,821a	86b	12.4a	6.4a	11.6a	989bc	23.4ab
42	16ab	1,772a	85b	12.3a	6.1ab	11.2a	1,054abc	23.3ab
43	18ab	1,829a	87b	12.8a	6.7a	10.6a	818c	22.8b
51	15ab	1,788a	84b	12.0a	5.8ab	12.3a	927c	23.2ab
52	16ab	1,719a	83b	11.7a	5.2b	12.0a	1,231ab	23.8ab
53	15ab	1,813a	81b	12.5a	6.1ab	11.3a	1,293a	24.2a
61	19ab	1,815a	83b	12.4a	6.1ab	11.6a	1,091abc	23.8ab

[1]Means in a column not having a suffix letter in common are different at the 95-pct level of significance.
[2]See table 1.

Table 8.—Results of normalizing the yarn-property values of open-end yarns[1]

Code No.[2]	Break factor	Yarn appearance index	Single-strand strength (g/tex)	Single-strand elongation (pct)	Single-strand strength CV (pct)	Neps (No./1,000 yd)	Evenness CV (pct)
21	1,647a	79.8a	9.8ab	6.1abcd	7.7a	617bc	15.5abc
31	1,571a	79.0a	9.6ab	5.3d	8.1a	795ab	15.9ab
32	1,643a	73.0bc	9.9a	6.5a	7.9a	599c	15.3c
33	1,624a	71.4c	9.8ab	6.1abc	8.2a	621bc	15.5abc
41	1,625a	73.0bc	9.24b	5.5cd	9.0a	621bc	15.39bc
42	1,560a	71.2c	9.5ab	5.8abcd	8.4a	632bc	15.42abc
43	1,609a	75.0abc	9.8ab	6.3ab	7.7a	622bc	15.36bc
51	1,532a	78.0ab	9.20b	5.5bcd	9.1a	621bc	15.2c
52	1,553a	79.5a	9.4ab	5.4cd	8.7a	602c	15.3c
53	1,639a	76.0abc	10.0a	5.8abcd	8.0a	836a	16.0a
61	1,567a	75.0abc	9.5ab	5.8abcd	6.9a	662bc	15.44abc

[1]Means in a column not having a suffix letter in common are different at the 95-pct level of significance.
[2]See table 1.

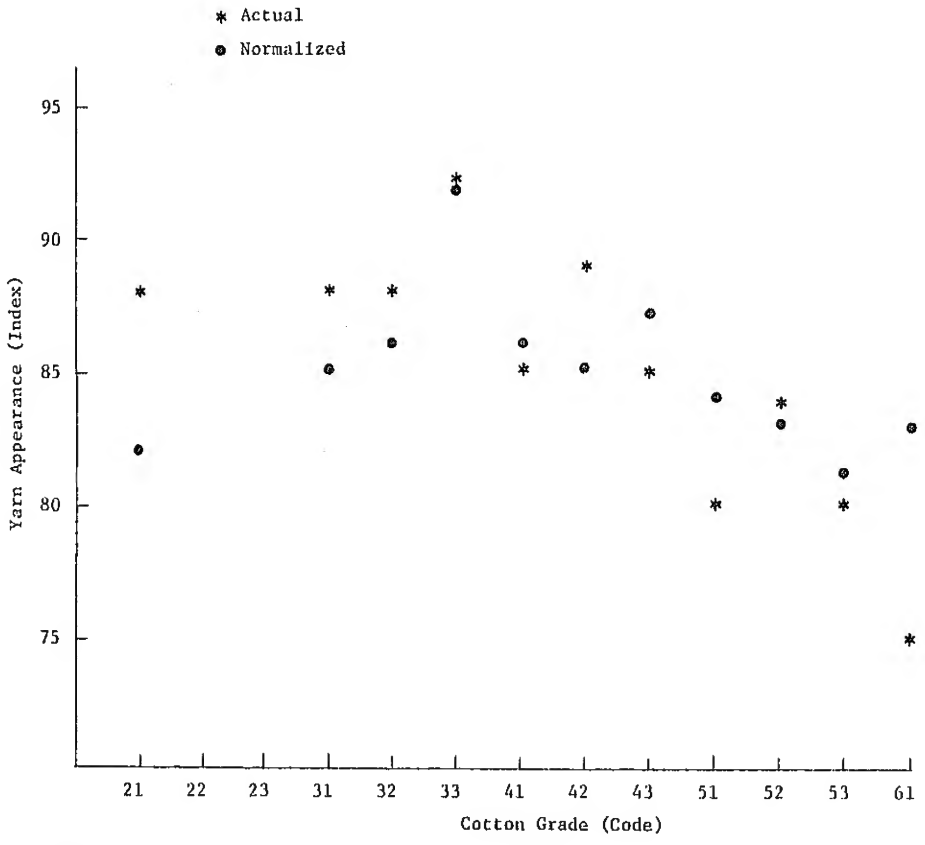

FIGURE 2.—Actual and normalized yarn appearances for ring-spun yarns versus cotton grade.

for the open-end yarns, there was a trend for a high yarn appearance index to be associated with a high level of neps and high evenness CV value. The SGO cotton (61) produced one of the weaker yarns; its strength CV was the lowest recorded. It also produced one of the lowest appearance indices, but it had relatively few neps and a low evenness CV. The SM cotton (21) had good strength and appearance, but it had a relatively high nep count and low evenness CV.

LIZED YARN-QUALITY

spun performance and yarn ties

effects of the variability in the selected es were removed, the highest number (table 7) were produced by SM (21) and the lowest by MSp (33). The highest break factor was achieved for M (31) and the lowest for LMLtSp (52). The LMLtSp cotton also produced the lowest elongation, while SLMSp (43) produced the highest. The LM cotton (51) produced the highest strength CV and SLMSp (43) the lowest. The MSp cotton produced the highest appearance index and the second lowest number of neps. The SLMSp cotton had the least number of neps and the best (lowest) evenness CV. Yarn appearance index was lowest and neps and evenness CV were highest for LMSp (53). Actual and normalized yarn appearances are plotted against cotton grade in figure 2.

Open-end yarn properties

After the effects of the selected fiber properties were removed, no grade had a majority of desirable or undesirable yarn properties (table 8). In some cases high strength and low evenness were not compatible properties. For example, LMSp yielded the highest single-strand strength and the highest (worst) evenness CV. Conversely, LM (51) had the lowest (best) evenness CV and the lowest (worst) single-strand strength. Therefore, for open-end spun yarns grade designation is not a good indicator of yarn quality. Actual and normalized yarn appearances are plotted against cotton grade in figure 3.

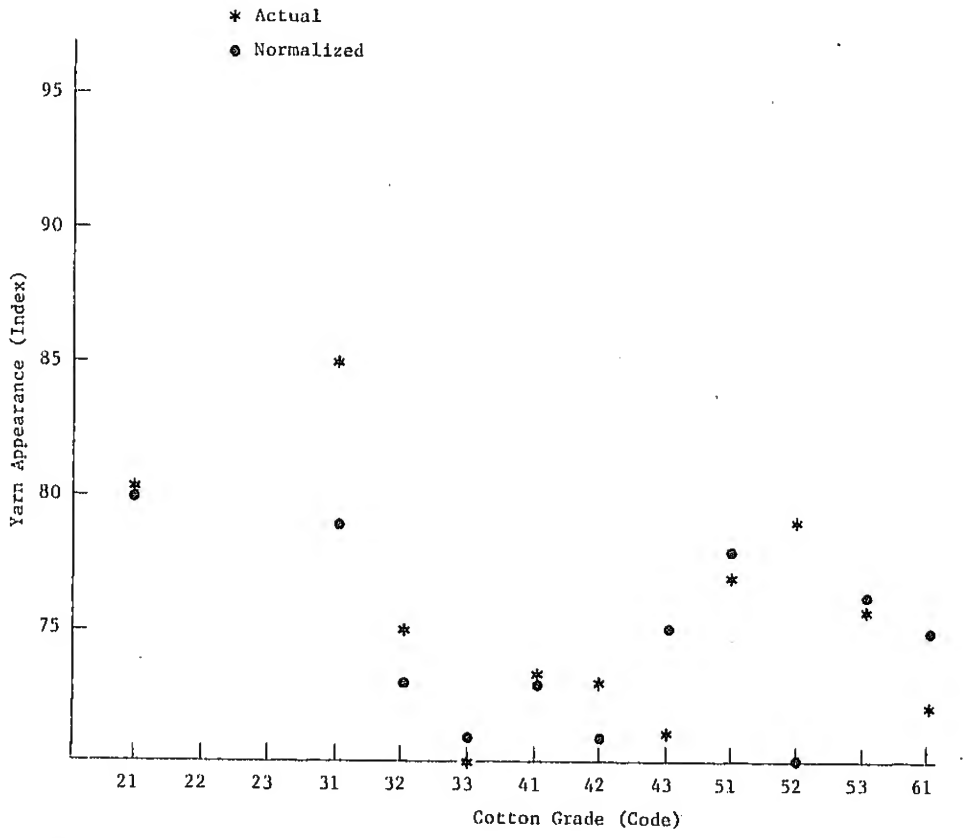

FIGURE 3.—Actual and normalized yarn appearances for open-end yarns versus cotton grade.

RELATIONSHIP OF GRADE TO YARN PROPERTIES

The multiple regression r^2 values and probability levels of actual and normalized yarn data for the ring-spun and open-end yarns are given in table 9. For the ring-spun yarns, all the properties except evenness CV had r^2 values that were significant at the 95-percent level (0.05 probability). For the open-end yarns, break factor and single-strand strength had r^2 values that were significant at the 95-percent level. Single-strand elongation of the open-end yarns was the only property that had a higher r^2 value after the data were normalized. The r^2 values for the ring-spun yarns imply that from 50 to 80 percent of the variation in all but one property is attributable to differences in grade. The r^2 values for the open-end yarns imply that 60 to 65 percent of the variation in strength is attributable to differences in grade. After the effects of variations in span length, length uniformity, Pressley strength, and micronaire were removed, no significant amount of the variation in the ring-spun yarn properties could be attributed to grade. The same trend existed for the open-end yarns, except that grade was responsible for 60 percent of the single-strand-strength elongation.

The differences in the fiber properties of the individual grades appear very insignificant amined separately, but the collective effe differences appears to be responsible for part of the variation in the yarn propertie grades.

CONCLUSIONS

The results of this study indicate tha ning performance and yarn quality of the were more dependent on fiber properti official grade. The cotton classer is app fluenced by differences in fiber propertie makes an assessment of color, trash, a ration of a sample. Grade designation, h a good indicator of the waste genera processing. After the effects of var 2.5-percent span length, length uniform

..sion r^2 values and probability levels of actual and normalized yarn data for ring-spun and open-end yarns

Yarn property	Ring-spun yarns				Open-end yarns			
	Actual yarn data		Normalized yarn data		Actual yarn data		Normalized yarn data	
	r^2	Probability	r^2	Probability	r^2	Probability	r^2	Probability
Ends down	0.778	0.002	0.047	0.824	....	....	....	....
Break factor	.744	.004	.046	.829	0.647	0.016	0.431	0.105
Single-strand strength	.616	.022	.083	.706	.597	.026	.280	.269
Single-strand elongation	.519	.054	.208	.394	.463	.083	.602	.025
Single-strand strength CV	.830	.001	.403	.127	.240	.334	.005	.981
Yarn appearance index	.798	.002	.278	.272	.420	.113	.165	.485
Uster neps	.599	.026	.175	.464	.179	.454	.038	.858
Evenness CV	.183	.446	.036	.865	.284	.263	.028	.269

sley strength, and micronaire were removed, there did not appear to be any relationship between grade and spinning performance or yarn quality. Classer's grade appears to be a very broad assessment of the spinning quality of a bale of cotton. The light spotted and spotted cottons tended to have slightly better overall fiber properties than did the corresponding white cottons. These differences resulted in better spinning performance and yarn quality for the light spotted and spotted cottons. The use of grade as an estimate of spinning quality can be misleading because of the fiber-property bias imposed by the classer. A high appearance index is usually associated with a low evenness CV in a yarn. However, for the open-end yarns, the best appearances were associated with high (poor) evenness CV and vice versa.